MS Material

M-B
125.00

The American Wonderland, The Yellowstone National Park.

By CHAS. T. WHITMELL, M.A., H.M.I.S.

Read (in part) before the Cardiff Naturalists' Society, Thursday, 12th November, 1885.

Illustrated by Maps, Pictures, Photographs, and Specimens.

Hon Edwards Pierrepont
103 Fifth Avenue New York
U S A

The American Wonderland, The Yellowstone National Park.

By CHAS. T. WHITMELL, M.A., H.M.I.S.

18 Park Place —— Cardiff. England.

Read (in part) before the Society, Thursday, 12th November, 1885.
Illustrated by Maps, Pictures, Photographs, and Specimens.

SYLLABUS :—Situation and General Features. History. Salt Lake City to the Forks of the Fire Hole River. Sulphur Mountain. Great Falls and Grand Cañon of the Yellowstone River. Yellowstone Lake. Lower and Upper Geyser Basins of the Fire Hole. Hell's Half Acre. Gibbon Geyser Basin. Obsidian Cliff. Mammoth Hot Springs. Tower Falls. Cinnabar Mount and Devil's Slide. Second Cañon (glaciers). Livingston. Origin and Theory of Geysers, etc.

The accompanying lithographs have been very kindly contributed by T. H. THOMAS, Esq., R.C.A.

SOME eighteen months or more ago, your esteemed President, then our indefatigable Secretary, requested me to bring before the Society the subject of this evening's Paper. I had been back from America for only a short time, and I felt it would be better to defer the attempt. Rather more than two years have elapsed since I left the United States, and during that interval I have been accumulating notes and photographs, arranging specimens, and reducing observations to shape.

It affords me, therefore, great pleasure to be able now at last to speak on the matter with a better hope of doing justice to the subject, and of giving you some idea, however inadequate, of scenes and wonders never to be forgotten.

There are here a large number of photographs, chromo-lithographs, engravings, maps, and specimens, of my own collecting; but I wish especially to draw your attention to the remarkable and interesting series of water-colour sketches made by my friend Mr. Thomas, when in the Park last year. He has most kindly lent them, and also his own specimens, for this paper, and we are deeply indebted to him for so greatly aiding our comprehension of the subject. My only regret is that, being away from England, he cannot be with us to-night; but though absent he yet speaketh in these beautiful fruits of his genius.

In a letter recently received he writes :—"It may be proper to say, " in excuse of the roughness of some of the sketches, that they are " almost untouched travel sketches, quite half, if not more, of the Park " ones being taken on the logger-head of the Mexican saddle of my " Cayuse, for I often feared to dismount lest the lariat should break, " and I should be left to 'weary plod my homeward way' with the " thermometer drop, drop, dropping down to freezing point."

You will agree with me that Mr. Thomas need have sent us no excuse ; the very want of finish in some of the pictures is one of their chiefest charms—they come, as it were, red-hot from the artist's anvil.

One more preliminary statement :—I have been greatly embarrassed by the magnitude of the task undertaken, and the following account will be found to contain a good deal that was necessarily omitted during the reading of the Paper.

Square Brackets [ ] enclose quotations.

SITUATION AND GENERAL FEATURES.

Speaking broadly, the boundaries of the Yellowstone National Park are, north and south, the parallels of 45° and 44° north latitude, east and west the meridians of 110° and 111° longitude west from Greenwich. The area is rectangular, measuring about 55 miles east to west, and 65 miles north to south : that is, about 3,575 square miles. The average elevation is nearly 8,000 feet above the sea-level. Placed mainly in the north-west portion of Wyoming Territory, the Park includes also portions of southern Montana and eastern Idaho Territory.

Putting the matter more popularly, we may say that about half-way between the Pacific Ocean and the Upper Mississippi, and in the same latitude as Lake Champlain, the Rocky Mountain system develops a remarkable series of peaks and ridges, enclosing the most wonderful Lake-basin in the world.

Hence radiate great mountain ranges, and here are born the springs of the Missouri, the Columbia or Snake, and the Colorado of the West, three of the mightiest rivers of the States. The Continental Water-parting or Great Divide, separating the Atlantic and the Pacific-seeking streams, traverses the south-western portion of the Park.

[Set like a gem in the centre of this snow-rimmed crown of the continent, is the loveliest body of fresh water on the globe, its dark-blue surface at an elevation greater than that of the highest clouds that fleck the azure sky of a summer's day over the tops of the loftiest mountains of the East. Its waters teem with trout, and the primeval forests around are crowded with game.]

But the Lake is only one among the many wonders of this Wonderland.

[Here Nature puts forth all her powers to astonish, terrify, and delight, and her moods are ever changing from "grave to gay, from lively to severe." Here tremendous geysers shoot up their mighty fountains, causing the earth to groan and tremble at their violence ; countless hot springs, indescribable in their strange beauty, show depths

UPB

as translucent as the ambient air; pools of seething mud, casting up jets of coloured paste, bewilder by their curious activity. Then there are serried snow-mantled mountains, profound cañons, mighty cataracts, verdant valleys, beautiful woods, sylvan streams, foaming cascades, mirror-like lakes.]

Nowhere else, I believe, can be seen, on so grand a scale, so close to the surface, such clear evidence of dying volcanic action. We seem to witness the death-throes of some great American Enceladus. Were there but a living glacier (the moraines of the vanished are there) and an active volcano, the cup of wonders would be full.

Such then, in brief, is the region set apart by the public-spirited Government of the United States. A Park which shall be " a grand national playground, a museum of unparaleled—indeed incomparable—marvels, free to all men for all time."

The area is really less one great Park than a group of small ones. High rolling plateaux, broken by valleys, cliffs, and cañons. The loftiest point is Electric Peak (11,155 feet), the lowest the mouth of Gardiner River (5,360). As might be expected from the elevation and latitude, the climate is subarctic, the days in summer warm, the nights cool and seldom free from frost, and the air dry. Agriculture therefore is not profitable, and the volcanic nature of the rocks makes it very improbable that minerals worth mining will be found. These circumstances had, of course, great weight in helping Congress to the decision they made in 1872, to set the area apart for a National Park.

HISTORY AND EXPLORATIONS.

The earliest reference to the hot springs is in the stories of a trapper, named Colter, probably the first white man who ever saw them. Between 1806 and 1810 he lived for some time with the Bannock Indians, who ranged through the country in which the Park is now located. He told wonderful tales of the region, which were not believed. "Colter's Hell," as the place was named by the hunters who heard his stories, was classed with Lilliput and other imaginary regions. In 1844, James Bridger, a noted Rocky Mountain guide, is said to have described some of the springs and geysers, but could get no Western newspaper to publish his marvellous account. In 1853, Captain Mullan, in one of his reports, speaks of the existence of an infinite number of hot springs at the headwaters of the Yellowstone, etc.

In 1859, Captain Raynold refers to the fact that he was unable to penetrate the region, and had to be content with listening to marvellous tales of burning plains, boiling springs, etc. He also mentions Bridger's narrative, in which is described a boiling spring, a perfect counterpart of one of the geysers of Iceland; and states his opinion that Bridger's account, being that of an uneducated man, who probably had never heard of such wonders elsewhere, may be taken, with but little doubt, to be true. Captain De Lacey, who, with a prospecting party, visited the district in 1863, speaks (in a paper he published) of hundreds of hot springs, etc., on the south fork of the Madison.

In 1869, two prospectors came to the region in the hope of finding gold, and the account of their trip, which appeared in a Chicago magazine, is probably the first authentic description ever issued. Their story immediately attracted attention, and, in 1870, a large party, composed of citizens of Montana, under General Washburn, explored the district; and illustrated articles by Mr. N. P. Langford, one of the explorers, appeared in Scribner's Magazine in 1871.

During 1871 and 1872, the Officers of the Geological Survey of the Territories made their explorations, and gave to the world the first scientific account of the region. This led, under the able advocacy of Dr. Hayden, the chief of the Survey, to the Act of Dedication, by which, on 1st March, 1872, the Yellowstone National Park came into official existence.

Since this date much valuable work has been done, and I may especially refer to the publication of the "Twelfth Annual Report of the United States Geological and Geographical Survey of the Territories (Wyoming and Idaho)" for the year 1878, issued in 1883, under the direction of Dr. Hayden. To this Report I am very largely indebted for much valuable information.

This brief historical résumé will tell you how recent is the whole subject, and will explain why a good deal of confusion still exists with regard to it. Many English people mix up the Yellowstone Park with the Yosemite Valley, some 700 miles away in California. Both places happen to begin with a Y.

The Yellowstone river derives its name, I believe, from the fact that much of the rock near which it flows is yellowish. There appears to be an old French name *(Roche-jaune)* of the same meaning.

SALT LAKE CITY TO THE FORKS OF THE FIRE HOLE RIVER; 309 MILES.

Early on 17th August, 1883, I left Salt Lake City (Utah) for Ogden, and thence proceeded north by the Utah and Northern Railway to Beaver Cañon Station (Idaho), arriving there at 3 a.m. on the 18th. As this is the terminus of a stage-line to the Park (distant some 110 miles), arrangements were made here with Bassett Brothers to take me there. I paid about £20 for the use of a spring-waggon and pair of horses for twelve days. The driver was named Henderson, of Mormon parentage, but himself not a follower either of the Latter- or the Early-Day Saints. It was interesting to find that an English lady friend, who had crossed the Atlantic with me in the "Britannic," had started from Beaver Cañon only a day or two before.

The road to the Park is a natural one, the ground being good and generally level. It traverses a great lava plateau, a portion of the huge basaltic flood of Idaho. [It seems as if the vast plain of basalt had once been a big lake or sea of molten rock, which surged along the base of the hills, entering every valley, and leaving there a solid floor of bare black stone.] No eruption from ordinary volcanoes would account for this flood; the fountains of the great fiery deep would appear to have broken up, their contents welling forth through great rents or cracks in the surface. There is no slag or scoria, and only a few small cones are seen here and there. *Fissure* eruptions these outbursts have been named, and they furnish the key to similar phenomena in Scotland.

There was plenty of grass and other vegetation along our route, which crossed the Snake river twice. We camped for the night along its banks in tents at the lodge of a hunter called Rea, some 50 miles from Beaver Cañon. A good spot for sportsmen, for here are blackbirds, prairie chickens, wild geese, etc., and plenty of fish, to say nothing of larger game.

Next morning (19th) the temperature in the tent was 28° Fahr., and water was frozen. After breakfasting on elk, we started again for the Park, passing Henry's Lake, and crossing the South Fork of the Madison river. Entering among wooded hills, a steep ascent is made over a ridge, which forms part of the west boundary of the Park. The escarpment looked forbidding—dark and sulphury. The rocks are distinctly igneous, black decomposing obsidian, and white pumiceous-looking material, and the road cutting displays plenty of grayish black volcanic sand; whilst on the pine-wooded crest of the hill are scattered spheroidal blocks, like bombs, some 2 feet across.

I was now full of excitement, for the Promised Land had come at last; not simply the Pisgah-sight of years ago, but the reality. Descending the inner slope, and looking to the right, vapour was visible in the valley—the steam of the Geysers I had travelled 5,000 miles to see!

Marshall's Hotel was soon reached and became our head quarters for a few days. It is a wooden building, plain and unpretending, and furnished after the fashion of a house in the Backwoods, but for all that to be preferred to more pretentious places; for the proprietor and his wife were most civil and obliging, and did all they could to make their guests comfortable, evidently wishing to live *by* and not *on* them. There is a post-office in the hotel, and just opposite a bath-house, perpetually supplied with warm water from a natural hot spring. Besides the tourists in the hotel, there were several camping round under canvas.

The locality is called the *Forks of the Fire Hole*, because here occurs the junction of two streams, the Fire Hole river from the south, and its East Fork from the east, which, united, form the Madison, tributary to the Missouri. Roads radiate hence to the Mammoth Hot Springs on the north, the Yellowstone Lake and Falls on the East, and the Lower Midway and Upper Geyser Basins on the south, the first of these Basins being quite near to the Hotel.

Meeting two pleasant Americans, willing to share the expenses of the trap, I arranged with them to visit the Falls of the Yellowstone river to-morrow. Strolling round on this, my first evening in wonder-land, I was naturally much interested to notice the hot springs over-flowing along the river-bank, and the steam clouds hanging over the distant geysers.

The word *Geyser* will occur so often that it may be as well to explain it. The word is Icelandic, as it was in Iceland that geyseric phenomena were first recognised, and means "gusher" or "rager." The term came into use as the proper name of a particular spring—the Grand Geyser—and then became generic and applicable to the entire class of boiling fountains that spout hot water intermittently. The word *Volcano* has a similar history, for originally it was the proper name of one of the eruptive vents in the Lipari Isles.

20th AUGUST.—FROM THE FORKS OF THE FIRE HOLE TO THE FALLS OF THE YELLOWSTONE; 29 MILES.

I felt at first a slight prejudice against Henderson, for I overheard another driver—using the expressive vernacular of the West—describe him as a "Hell-roaring Mormon." I am all the more pleased, therefore, to state that any unfavourable idea induced by this polite and complimentary description passed altogether away, and was replaced by a feeling of regard for one who proved himself a good-tempered, friendly, and entertaining companion. By a curious coincidence, Henderson was also Mr. Thomas's guide last year.

This morning, as had been arranged, Reid and Whitman started with me for the Yellowstone Falls.

There being nothing but a foot bridge, we had to ford the river (the infant Madison) just below the Fire Hole Forks, jolting terribly over the bouldery bed of the shallow stream. The road goes for some miles up the valley of the East Fork of the Fire Hole (a fishless stream fed by hot springs), crossing it several times, and then ascends rapidly through noble woods. Fine views are unfolded; the Park lies below, and snow-patched summits of the enclosing mountains are seen rising beyond the steam clouds of the Fire Hole Geyser Basin.

The pebbly shores of *Mary's Lake* are now skirted. This silvery sheet of water, a quarter of a mile across, reflecting like a mirror the tall pine trees on its banks, is situated near the summit of the divide between the Yellowstone and the Madison, at a height of over 8,000 feet. Descending to the basin of the Yellowstone, a more open country is entered, named *Hayden's Valley*, formerly, it is believed, occupied by an extension of the Yellowstone Lake.

About a mile or two beyond Mary's Lake, a remarkable group of *Hot Sulphur Springs* occurs, near the head of Alum Creek. They cover several acres, and abound in fumaroles and solfataras, from many of which steam issues. [All these little chimneys, or orifices, are lined with the most brilliant crystals of sulphur. The basis of the deposit is silica, itself as white as snow, but variegated with every shade of yellow from sulphur, and with scarlet or rose-colour from oxide of iron. At a distance the place looks like a vast burning lime-kiln.]

The water flowing away I tasted and found to contain sulphuric acid, which, in combination with alumina and potash, would form the alum from which the Creek is named. The ground is covered with white rock, and I hesitated to approach very near the conical mounds lest the floor should give way, for it looked treacherous and sounded hollow. One seemed to be in a new world; but that it was a world of realities, not of ideas, I soon proved by scalding a finger in one of the steam jets.

We descended into *Hayden's Valley*, and in the pretty dell of Sage Creek (guarded by high bluffs, and covered with a wiry growth of Artemisia or sage-brush) found a very convenient spot for lunching. The water of this Creek, fortunately for us, was sweet and pure. Five miles further on the road divides; that to the north leads to the Falls, that to the south to the Lake.

Sulphur Mountain.—Passing on over sage-brush and grassy hills, a place of great interest is soon reached—*Sulphur Mountain*, or *Crater Hills*—a group of detached mounds or buttes (150 feet high) of white siliceous rock, stained here and there with iron, and containing sulphur. At the foot of these hillocks, and also in the pine-fringed plateau upon which they stand, are numerous springs and mud-pots. The most remarkable caldron is the *Yellow Sulphur Spring*, situated at the base of the loftiest mound.

[This measures 15 by 20 feet; the water boils up constantly from 3 to 7 feet in height, the whole surface rising and falling occasionally with a flux and reflux of 4 feet additional, so as to overflow. The basin is built up with a solid rim or lining of pure crystalline sulphur, 4 feet in width, and probably amounting to 40 tons in weight. The temperature is 197° Fahr.]

The greenish-tinted water goes on bubbling and boiling in the most fascinating way, forming great smooth round waves, whilst steam is ever ascending from the surface. One cannot go very close on account of the steam, and for fear that the edge might give way. All about this neighbourhood the ground sounded hollow, as if caverned beneath.

This uncanny caldron, which might well suit with the Witches in "Macbeth," is doubtless a dying geyser. The eruptive days are past, and it now does no more than boil over. The region is strongly suggestive of the Nether Fires.

From Crater Hills we pass over undulating meadows, and cross Alum Creek not far from its junction with the Yellowstone. The trail now winds through forest-land above the left bank of the river, and the sound of the *Upper Falls* is soon heard. For some 14 miles the river has been placidly flowing, from its outlet at the foot of the Yellowstone Lake, through a broad valley, its waters unbroken by rock or rapid. Then the valley narrows suddenly, the water surges in rapids, and leaps down in cascades, making madly for its plunge into the deep Cañon, which it has carved for more than 20 miles through the volcanic plateau.

The Upper Falls.—[These are not so grand as the Lower Falls, but, artistically considered, they are very attractive. The confining cliffs, crowned with pines, are from 200 to 300 feet high; the width of the Falls is 80 feet, their height or depth 112 feet. The water is churned by the rapids into creamy foam, and the torrent then shoots out into the air far beyond the brink of the precipice, falling into the deep-lying basin below. Rebounding from the rocks, it darts forward in fan-shaped surges, that spread over the sea-green surface of the pool, and sends up at the same time dense clouds of spray and mist which fully veil the lower third of the cataract, and lodge upon the moss-covered walls of the basin, to return again in countless rills to the stream.]

Not far beyond the Upper Falls, in a rocky dell opening down to the Yellowstone, we came upon the Tent Hotel, a series of canvas houses erected by the Park Improvement Company (horrid title !) preparatory to putting up more substantial buildings. Eager to see the main object of the day's expedition, we passed quickly over the picturesque Cascade Creek, and descended a rough steep track to the head of the *Lower* or *Great Falls*, where a railed platform affords convenient vantage ground for the view.

THE GRAND CAÑON AND GREAT FALLS OF THE YELLOWSTONE.

There is nothing in the Park, there are few sights in the world, so wondrous and so weird as the *Grand Cañon* and *Great Falls of the Yellowstone.** Turner, the world's greatest landscape painter, when at the height of his genius, might have rendered some justice to a scene which Nature has steeped in a wealth and variety of colour elsewhere unsurpassed. Where palette and pencil fail, how feeble the pen ! John Ruskin should see and tell of this place.

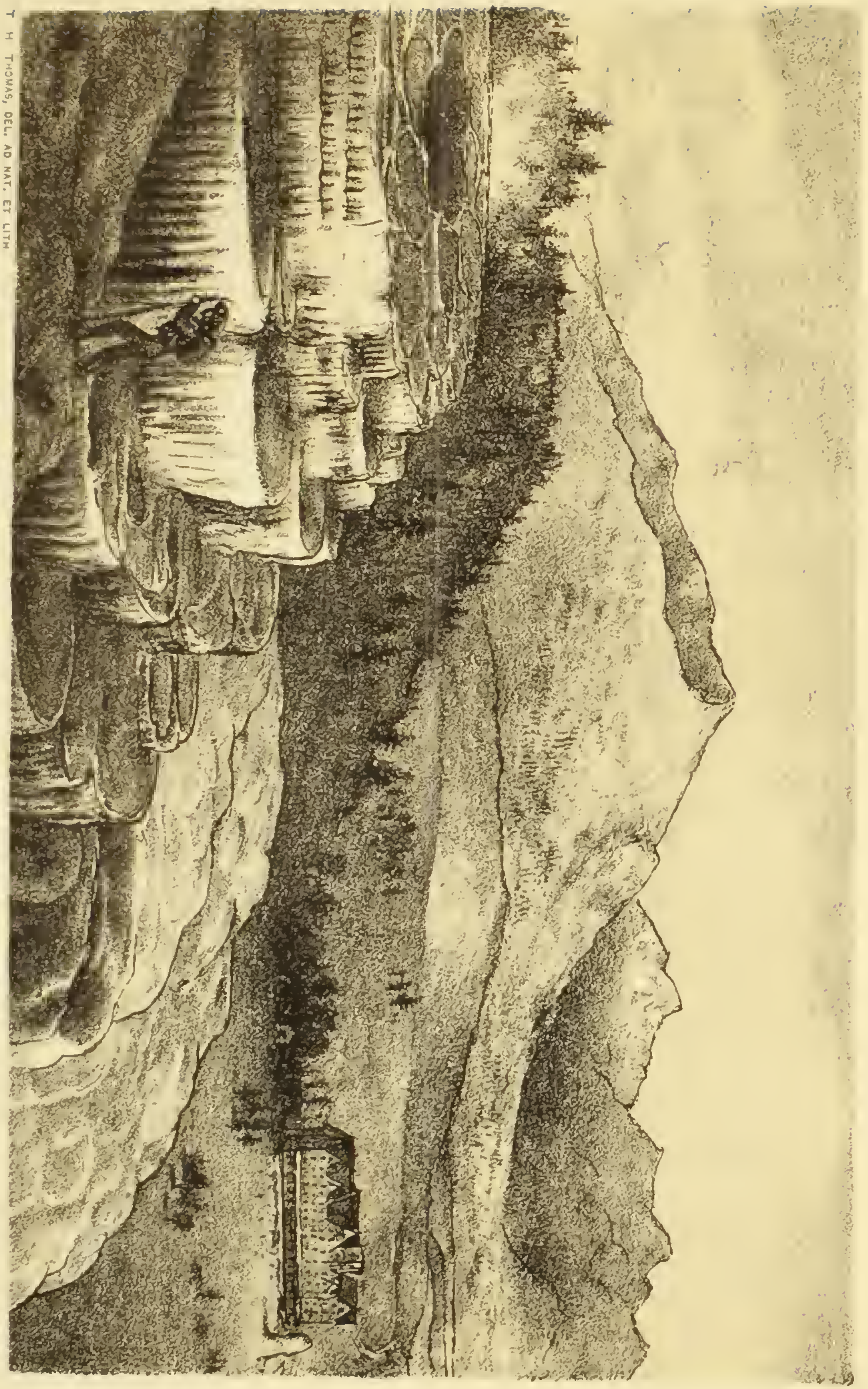
[The scene from the brink of the Falls, looking into the profound depth of the Cañon, is of strange majesty and indescribably awe-inspiring. The advancing volume of water flows rapidly and compactly to the brink, and falls with a tremendous shock into a large circular foaming caldron, bounded by cliffs 800 feet high. The masses of water seem to break into fleecy columns and sheets of glistening foam as they descend, but, nevertheless, they strike the pool below with a concussion so heavy that they are forced upward in fountains of spray and clouds of mist, which wash the sides of the Cañon, nourishing a rank growth of green mosses and algæ. The river finds its outlet through a narrow throat at the foot of the pool, appearing in the distance like a streaming ribbon of satin laid along the depths of the Grand Cañon, behind the winding walls of which it is lost to view.]

The depth of the Great Falls is some 300 feet, the width about a third of that amount. It is of interest to note that both Falls are due to ridges of hard rock crossing the course of the stream. On the geological map the rock, over all this portion of the country, is named Rhyolite—an igneous rock ; and considering the difficulty of correctly naming such materials, I give the names without pledging myself as to their exactitude.

Along the sides of the Cañon the walls are at many places fashioned into pyramids, reminding one of those (of very different material) near Botzen, in Western Austria. The yellow, deep red, and other tints are doubtless due to the action of hot springs, the weathering of the rock, the presence of sulphur, and the oxidation of iron, which here, as elsewhere, is Nature's principal pigment.

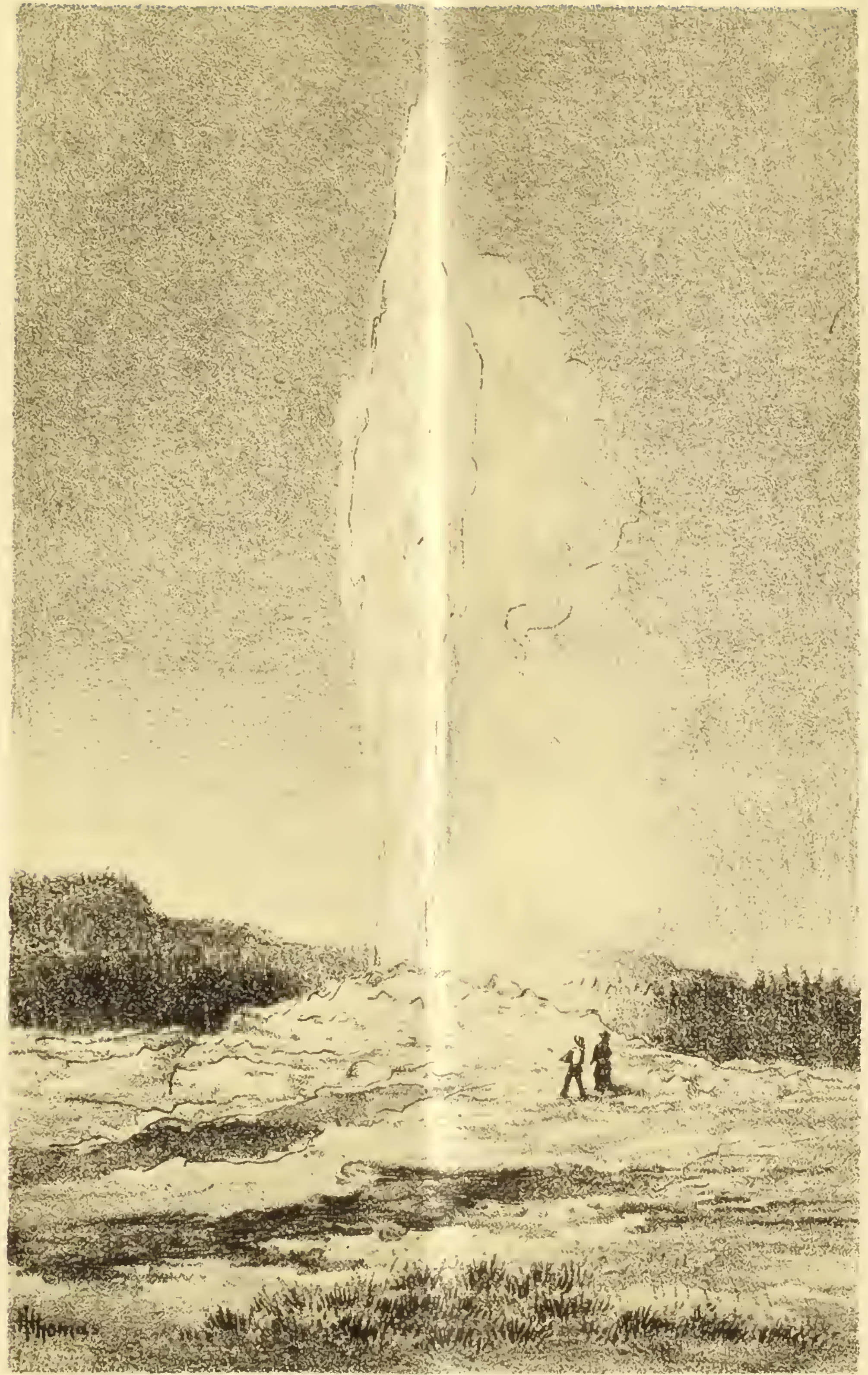
---

* See Lithograph.



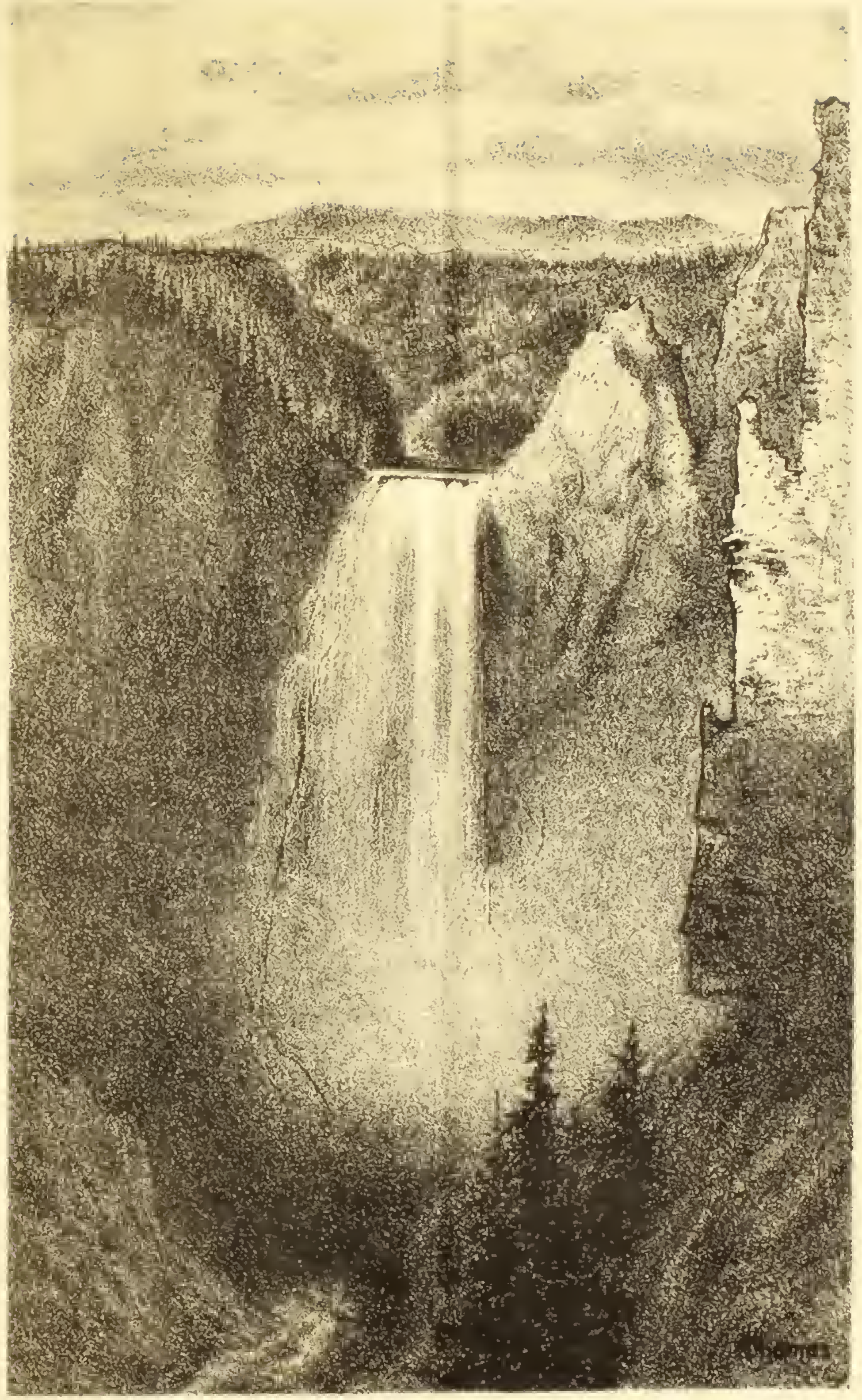
T. H. Thomas, del. ad nat. et lith.

Stalactitic Terraces and Cleopatra Basin, Mammoth Hot Springs.



T. H. Thomas, del. ad nat. et lith.

"Old Faithful" Geyser in Eruption (Height, 120 feet).



T. H. Thomas, del. ad nat. et lith.

Grand Canon and Great Falls (300 feet) of the Yellowstone.

Reluctantly leaving the Falls, Whitman and I followed a steep bridle path to *Point Lookout*, an eminence projecting from the cliffs of the left bank about a mile further down. Hence the views are of strange and transcendent beauty. Up the pine-fringed gorge we look to the Great Falls, and down we gaze along a still deeper cañon with black basaltic walls, whilst below runs the river—a ribbon of emerald. Like some of the Tyrolean Dolomites, one notable pinnacle stands drenched crimson as with the blood of sacrifice, whilst near it rises a cliff, white as the chalk of Dover. Trees rooted in the rifts, mosses margining the stream, soften the savagery of the scene.

[The Falls—writes Dr. Hoyt—are not the grandest in the world, but there are none more beautiful. There is not the breadth and dash of Niagara, nor is there the enormous depth of leap of some of the Yosemite waterfalls. But here is majesty of its own kind and beauty too. . . . . But your eyes are distracted from the Falls to their marvellous setting, to the Cañon into which the river leaps, and down whose glooms the Falls unroll their whiteness. The rocky sides are almost perpendicular, and in many places the boiling springs have gouged them out so as to leave overhanging cliffs and tables at the top. Nothing more awful have I seen than the yawning of that chasm. Stillness solemn as midnight, profound as death. The water dashing there, as in a kind of agony, you cannot hear; the mighty depth of distance lays the finger of its silence on the white lips.

But this is not all, nor is the half yet told. Mark the sculpturing of God upon those vast and solemn walls. By dash of wind and wave, by file of snow-plunge glacier and mountain torrent, by the hot breath of boiling springs, those walls have been cut into the most various shapes. There are the mediæval Castles of the Rhine; there, only loftier and sublimer, are the prototypes, as it were, of the soaring summits of cathedral spires in the country beyond the sea.

But beyond all else you are fascinated by the magnificence and utter opulence of colour. Those are not simply gray and hoary depths and reaches, domes and pinnacles of sullen rock. The whole gorge flames. It is as though rainbows had fallen out of the sky and hung themselves there as glorious banners. The underlying colour is the clearest yellow, this flushes onward into orange. Down at the base the deepest mosses unroll their draperies of the most vivid green; browns sweet and soft blend together; white rocks stand spectral; turrets shoot up crimson as though they were drenched through with blood. It is a wilderness of colour.

What you, accustomed to the softer tints of Nature, would call a great exaggeration, would be the utmost tameness compared with the reality. It is as though the most glorious sunset you ever saw had been caught and held upon that resplendent awful gorge.]

This is better than any description I can write. I can confirm it, and can echo the words with which it closes:—that to have seen the Grand Cañon of the Yellowstone is an epoch in my life. Great was my regret at being unable to spend longer there, in order to witness the different effects produced by the morning and evening lights. The

Crater of Vesuvius is the only other place in which I remember to have seen such a variety and wealth of natural colour.

The depth of the gorge varies from 1,200 to 1,500 feet, the width is about half-a-mile, and the walls are precipices or inclined at a fearful angle.

Returning to the Hotel, it was pleasant to find there the English lady (before referred to) whom I had last seen at Manitou (Colorado); and an English artist, whose pictures were remarkably faithful representations of the wonders he had seen. He had taken the trouble to procure pieces of the tinted rocks in order to ensure correctness.

Thos. Moran, the celebrated American painter, is, I believe, the only one who has attempted to paint this neighbourhood on a *large* scale.

Dinner in the great tent, decorated with greenery, a pleasant chat round a big fire under the star-lit sky, and then to sleep in a small tent bedroom, brought this ever-memorable day to a close.

21st AUGUST. FROM THE FALLS TO THE LAKE AND BACK; 40 MILES.

It was very cold in the tent this morning, thermometer 36° Fahr. A remark may here be made upon the great difference between the day and the night temperature. At the elevation of the park (8,000 feet) the air is rare and dry, and the mitigating influence of aqueous vapour being much reduced, the contrasts are extreme. In Summer, also, but little rain falls.

The trail of yesterday was retraced as far as the forks of the road near Crater Hills, and thence the valley of the Yellowstone is followed for some eight miles to the Lake foot.

About five miles before reaching it we came upon some *Mud Geysers.* The most remarkable is called the *Giant's Caldron*, hollowed out of the slope of a wooded hill. Thirty feet across, as many deep, and narrowing as it descends, it presents a yawning crater, in which the boiling slate-coloured mud rises and falls with a deep rumbling sound. After the paste is sucked back into the orifice there comes a jarring noise as of some explosion, and out surges again the horrid mixture, flinging its heavy spray against the walls of the crater, which is sometimes filled nearly to the top, steam meanwhile escaping in large volumes. There is something very alluring, and yet very horrible, in the sight. In the neighbourhood is a great deal of the usual white sintery ground, in which occur big circular pools of water, probably the sites of dead geysers.

Close to the Giant's Caldron is the *Grotto*, a large boiling spring of perfectly clear water. The entrance of its cavern is shaped like a small Gothic arch, and the walls are brightly tinted. The action of this spring much resembles that of the Caldron. The temperature of the water is 180° Fahr., and its clearness is attributed to passage through sandstone.

The Yellowstone hereabout is broad, and flows gently between wooded banks through a beautiful valley. At the exit at the N.W.

corner of the Lake the river can be forded. Twenty miles away, at the S.E. corner, the Lake receives the Upper Yellowstone.

Yellowstone Lake. Of this, as from limited time my acquaintance with it was slight I cannot write fully. For the elevation (8,000 feet) the Lake is the largest in the world, and there is evidence that at a former period the waters covered a much greater area, extending in one direction into Hayden's Valley. The coast-line (estimated at 300 miles) is exceedingly irregular, resembling the outline of a badly formed hand. The water is bluish-green in colour, clear, sweet, and pure.

From the foot the view is very grand. One looks across an inland sea (150 square miles in size), surrounded by snow-streaked craggy mountains.

[Signs of ancient volcanic action on the grandest scale are so abundant that the Lake-basin has been looked upon as the remains of a mammoth crater, 40 miles across; but this is not really the case.

Such a vision (exclaims Dr. Hayden, the sober-minded chief of the survey) is worth a lifetime, and only one of such marvellous beauty will ever greet human eyes.

Secluded amidst the loftiest peaks of the Rocky Mountains (writes Mr. Langford), possessing strange peculiarities of form and beauty, this watery solitude is one of the most attractive natural objects in the world. Long narrow inlets indent its southern shores, slender pine-crowned promontories stretch into it from the bases of the hills, islands of emerald hue dot its surface, and a margin of sparkling sand forms its jewelled setting. The winds from the mountain gorges lash its placid surface into waves, which break in foam upon the beach.]

East of the Lake rises one of the grandest volcanic ranges in the world—the Yellowstone Range; the general height of the mountains being 10,000 feet, whilst many rise 1,000 feet above this.

At several places along the shore occur hot springs, usually conspicuous by the snowy whiteness of their deposits. At some of these localities can be performed the feat of catching a trout in the Lake and cooking it in a hot spring, without so much as moving from the spot or unhooking the fish. (The same thing can be done near the Mammoth Hot Springs). The Lake trout, for some unexplained cause, are generally diseased.

The volcanic rocks encircling the Lake produce a beach of volcanic sand, black and shining; and seekers for them may find pebbles of obsidian, chalcedony, carnelian, agate, etc.

Leaving Henderson to enjoy an afternoon nap, I walked south for about five miles along the forest-covered west margin of the water. My object was to find the *Natural Bridge*, an arch of trachyte, spanning a mountain torrent; a structure not made with hands.

After a very rough, toilsome tramp I returned unsuccessful. Fallen timber was the main obstacle to progress, and is largely due to the fires which from time to time ravage these forests. I felt very lonely wandering through the tangled underwood; and further, in a book I had with me, there was mention of grizzly bears and mountain lions haunting the place; and the revolver had been forgotten. However there appeared no creatures more formidable than those lovely little squirrels called chipmunks, hundreds of which scampered about over the prostrate logs and up the trees.

Of the herds of elk, deer, and mountain sheep, that doubtless thronged these woods in the pre-touristic period, I saw nothing; but there is still plenty of wild fowl.

When Mr. Langford's party explored this region, and found themselves in more than usual difficulty, and were therefore relieving their minds by a more than usual variety and profusion of expletives, good humour was at once restored by one of them theatrically declaiming :—

> "There is a pleasure in the pathless woods,
> There is a rapture on the lonely shore."

Over thousands of acres in the Park stand forests of *dead* trees, ghostly to look at by daylight, but spectral indeed at night. Is it frost or fire that has wrought this desolation ?

Until a steamer is provided it will be impossible for the ordinary tourist to obtain anything beyond a very partial knowledge of the Lake.

Not far from the S.W. border of the Lake runs the *Continental Divide*, and upon its summit is the so-called *Two-Ocean Pond.* This I should much like to have seen, for a lake with *two outlets* is, I believe, an impossible *lusus naturæ*, existing in imagination only.

On the way back I noticed at many places along the river bank signs strongly suggestive of morainic terraces and filled-up lake basins.

The night was spent at the Falls Hotel, reached too late, alas ! for another view of the Grand Cañon.

22nd AUGUST.—FROM YELLOWSTONE FALLS TO FIRE HOLE FORKS; 29 MILES.

On awaking this morning at six o'clock, the water in the tent was frozen, and the thermometer down to 22°. Henderson, my guide, was comparatively new to the Park, so that I had to rely largely on the guide-books, in many respects a disadvantage. Another difficulty, that more than once occurred, was the straying of our horses during the night, so that much time was lost in finding them before starting

To-day we returned over the route traversed on the 20th, so there is little to add. We halted at Crater Hills, for I was wishful to see again the extraordinary Yellow Sulphur Spring, before described; and to look for some remarkable *Mud Pots*, then missed.

These are very interesting and extensive (covering about four acres), and in number are about fifty.

[The mud is of different degrees of consistency, and has been compared to mush, hasty-pudding, and mortar. It boils slowly, with bubbles of gas escaping, and is spouted sometimes to a considerable height, the splashes falling back around the edges of the craters. In some of the springs the mud is white, in others yellow; in others, again, pink. Though close together, these mud pots appear to have no connection with each other.]

In the case of the principal mud spring—the *Blue Mud Pot*—(35 feet in diameter) Dr. Hayden states that the escaping gas is sulphuretted hydrogen, and that the mud is largely impregnated with alum. I suppose one might speak of these springs as small mud volcanoes.

We trod about very gingerly; for my own part I could never get rid of the impression that the white, hollow-sounding surface might at any moment break in, and let one through to an uncomfortably warm region.

On getting to our former camp on Sage Creek, the temperature in the sun was 96°, in the shade 62°. This evening I was again back at Marshall's Hotel, and enjoyed the luxury of a *natural* warm bath.

23rd AUGUST.—FORKS OF FIRE HOLE TO UPPER GEYSER BASIN; 11 MILES.

Henderson and I started about eight o'clock this morning, following the waggon road southward along the east bank of the Fire Hole river.

Lower Geyser Basin.—The lower part of the valley is broad, open, and marshy. Within it, covering an area of 30 or 40 square miles, are situated the springs of the Lower Geyser Basin, more than 600 in number, and including 17 geysers. Among the more remarkable are the *Thud Group*, the *Fountain Geyser*, the *Mud Puffs*, the *Queen's Laundry*, etc,; but I was anxious to reach the Upper Basin, so did not stop to see these, but contented myself with noting the large areas of white sinter which pave the valley, and from which arise numerous steam clouds, especially visible on frosty mornings.

As we proceed, the valley narrows, and the Egeria Springs are passed, not far from which rise the *Twin Buttes*, two lofty dome-shaped hills of white rock, built up (I suppose) by geysers, of which they remain as monuments. Passing through the most wonderful geyser region in the world, we go straight to the Tent Hotel, located between the *Castle* and *Old Faithful*, not far from the stream.

Upper Geyser Basin.—[The principal geysers of the Park are in this —the Upper Geyser—Basin, which covers an area of about four square miles. The chief springs are situated within a distance of about a mile along either side of the Fire Hole River.

Both the volume and temperature of the stream may be greatly increased by an eruption of some of the larger geysers. The surface of the Basin consists of ridges and knolls, crowned with geysers and hot springs; and the sides are formed by heavily timbered mountains, 1,500 feet high, the pine being the prevailing tree. Clouds of steam hang here and there like palls, and columns of vapour float upward like water-wraiths from between the tree-tops of the surrounding forest. The earth is full of rumbling, gurgling sounds—it shakes and trembles. The air is laden with sulphurous fumes. Stupendous fountains of boiling water, veiled in spray, shoot heavenward (like cascades reversed), glittering in the sunlight, and then fall in a shower of flashing pearls to the ground.

The various geysers are never simultaneously in action, and their periods of eruption are more or less irregular. Many which now exist will doubtless die, and new ones may arise.

An excellent point for a comprehensive view is a high mound (an old crater) near Old Faithful. This geyser regularly every hour sends its stream of boiling water 120 feet upward, playing for five long minutes; a grand exhibition, sufficient of itself to satisfy the most exacting sightseer. But there are many others of greater power.

In the foreground looms the imposing *Castle*, looking like a feudal fortress, and sending out its steam clouds and heavy jets of boiling water. Across the river is the *Beehive*, which about twice a day from its shapely crater throws up a narrow column, over 200 feet in height. A few rods beyond is the sapphire pool, out of which the *Giantess* plays fortnightly her stupendous fountain. Close by are the *Lion*, the *Lioness*, and her two *Cubs* (much given to growling). Farther down the stream are the *Saw Mill*, which keeps up a harsh burring; and the *Grand*, which twice a day displays its majestic power.

Besides these are many others of minor calibre, as well as countless steam vents and jets of scalding water, from all of which the flow is carried off to the river by innumerable rills, that stain with brilliant colours the white sinter over which they flow.

Close to the river's left bank stands the high cleft cone of the *Giant*, surrounded by his noisy retainers, among whom *Young Faithful* is the most vociferous. These cease their turbulence only when their mighty master is himself in action.

To the left of this colossus is the *Grotto*, whose labyrinths are thickly encrusted with beads of pearl-like silica. Further towards the south are the *Fan*, with diverging jets, the *Riverside*, etc., etc.

There are no less than 440 springs, of which 26 are known to be really geysers. Among the springs are scores, the astonishing beauty of which, with respect to colour, depth, and translucency of water, and delicacy, variety, and richness of siliceous incrustation, cannot be adequately described.

The surface of the ground, where it does not consist of the white sinter from the springs, is composed of black sandy material, the *débris* of the surrounding volcanic rock, rhyolite, and obsidian.]

As in duty bound, my first visit was paid to the best known geyser in the basin, *Old Faithful*,* so named by Mr. Langford, in 1870, and well sustaining the reputation for constancy then obtained.

The first of the eruptions I saw was at 11.5 a.m., the sixth at 6.30 p.m.; but I missed seeing two of them, so that, dividing the period by 7, we get 63½ minutes, or, roughly speaking, an hour, between each eruption; and such also was the experience of the early observers, 15 years ago. The geyser continues to play for about five minutes, sending up its column of water to an average height of 120 feet.

---

* See Lithograph.

The crater is oblong (measuring 2 by 6 feet), and is situated on a large white mound of geyserite, rising a dozen feet above the surrounding level. This mound, beautifully scalloped and terraced, and containing many small basins, has of course been built up by deposits from the overflowing water, geysers being their own architects. Both inside and outside the crater the silica has been laid down in forms and colours of rare delicacy. Rosy, gray, and yellow, coralline, nodular, and pearly, are some of the descriptive terms applicable to these deposits.

Old Faithful is near the south end of the valley, of which it has been called the Guardian. Steam is constantly escaping from the crater, and increases in amount as the time for action approaches. Explosive bursts occur, slight at first, but getting more and more pronounced, the water surging up and then retreating with a deep rumbling noise.

Then the leaps suddenly get higher and higher, and finally a majestic fountain of boiling water spouts up to a height of 40 yards, or more. Should there be a breeze and sun, the spray is blown aside, a great curtain of vapour drifts leeward, and a rainbow appears, like a symbol of Peace in the storm.

The column sinks somewhat suddenly, and after one or two abortive spurts, disappears within the smoking crater. Streams of steaming water run down over the sides of the mound into the river, and the eruption is at an end. It is possible to stay quite close by the windward side of the orifice during the whole of the wondrous display. At this elevation (7,400 feet) water boils at a temperature of 199°; that actually observed during an eruption was 200°.

There are many cones or mounds of extinct geysers near Old Faithful, which is, as it were, the living junior representative of a numerous family now dead. Geysers commit suicide, sealing themselves up by their own mineral deposits; building white sepulchres, which remain to mark the once active fountains.

After lunch I crossed the river to the *Beehive*, an eruption of which, we were told, was soon due. It is said to go off at least once in 24 hours, but this is a point not yet clearly ascertained. Very careful and prolonged observations of the different geysers must be made before any local "Bradshaw" can be published.

Lying on the hard white rocky bank sloping down to the river, I waited a long time, patiently roasting under the hot afternoon sun, the glare of which on the sinter was quite painful. (I should advise visitors to take snow spectacles.)

The Beehive cone, beautifully coated with beaded silica, is small, being only about a yard high. A few feet from it is a little steam vent. This was in vigorous action, and when so an eruption may shortly be expected.

After several futile attempts, and after I had almost lost hope, the eruption took place, lasting for six minutes (3.6 to 3.12 p.m.)—a splendid and magnificent sight.

No other geyser quite resembles this one. The water escapes in a steady stream with great force, much after the fashion of that from a fire-engine; the fan-shaped column, accompanied by spray and steam, reaching a height of 200 feet. But little water falls, the spray appearing to evaporate.

The power of this natural boiler is prodigious, the ground in the vicinity being shaken. Several interesting experiments were tried. Large logs of wood, placed across the jet, were easily whirled up to a height of at least a hundred feet. Instead of throwing up our hats we entrusted them to the geyser, which accomplished their elevation far more effectually. Amongst the spray a low rainbow was visible.

The whole sight was most exciting and exhilarating, and I felt myself very fortunate, in so brief a visit, to have witnessed it.

Leaving the Beehive, I wandered about from wonder to wonder; but limited time and space compel me to leave untold the half, nay more than that, of what was seen; the pictures, photographs, and specimens must speak for me. Some of the largest geysers have no raised cones, but simply deep circular pools, *e.g.*, the *Giantess.* In contrast to this the *Giant* has a cone or chimney 10 feet high.

This is a truly magnificent geyser, erupting every fourth day, throwing up a column, seven feet across, to a height of 70 yards, and doubling by its discharge the volume of the river, which here is 75 feet in width. Unfortunately I did not see it in action. On one side the crater is broken down, so that the interior, which is lined with a mosaic of brilliantly coloured silica, can readily be examined.

Round about the base of the Giant the sinter floor is covered by a very peculiar substance, soft, moist gelatinous, and to the tread something like seaweed. It is coloured red and green, and dries up to a brittle easily powdered crust. This leathery silica (may it not be a colloidal form ?) has been made into a new mineral species, and named *Viandite.* It would be interesting to discover its mode of formation, and whether there is any connection with the organic world.

I must pass over, with a mere mention of their names, the Lion, Lioness, Cubs, Sawmill, Grand, Turban, Riverside, Fan, Grotto, Pyramid, Punch Bowl, Castle, etc.

One of the springs last visited was an extinct geyser, called the *Black Sand*, lying among the Emerald Group, and rightly reputed one of the most beautiful in the Upper Basin. Hollowed out of a mass of black obsidian sand is a large funnel-shaped opening, whose sides slope gently to the surface of a deep pool. The water is of a lovely marine tint, and in its depths sleep complementary shadows tinged with sombre purple. Steam clouds rise from and drift over the nearly boiling liquid, half-revealing, half-concealing, a scene which in colour can be compared only to some molten jewel.

How easily a person might be cast into this natural caldron—murdered in fact—without anyone being able to prove the occurrence other than accidental! The place and the idea are commended to the attention of sensational novelists.

In the neighbourhood, near Iron Spring Creek (a tributary of the Fire Hole), occurs a large deposit of spongy geyserite, admirably adapted for bringing away in specimens; many collectors were at work on it. The stream flowing from the Black Sand Geyser to the Creek exhibits along its channels a series of beautifully delicate colours, pink, saffron, yellow, creamy-salmon, and green.

A puzzling but interesting fact in connection with the geysers is the want of sympathy between adjacent springs. One will be in violent eruption, whilst another close by is quiescent. There would seem to be no subterranean communication. Each acts with a characteristic transatlantic independence of every other, though I do not wish to imply that geysers, with all other things terrestrial, are not subject to the laws and constitution of the United States.

24th AUGUST.—FROM THE UPPER, TO THE GIBBON, GEYSER BASIN; 26 MILES.

Freezing, as usual, when I awoke this morning. Matters are very economically managed in the tent hotel here. In your canvas house you find no chairs, no mirror, a beer-bottle candlestick, perhaps one towel, and other things to correspond; and for these luxuries, and your food, you pay the small sum of five dollars (a guinea) a day.

Hell's Half Acre.—We drove northward down the valley to the *Midway Geyser Basin*, or *Egeria Springs*, a portion of which is better known by the expressive and euphonious title of *Hell's Half Acre.* (Even if to this area were added the sixth part of a cow, not many would say "thank you" for the allotment.)

This group of springs extends for about a mile along the river, and contains the largest geyser in the world, known as the *Cliff Caldron*, or *Excelsior Geyser.*

[It is an immense cavity, rather irregular in outline, and measures 300 by 200 feet. The water, of a deep blue tint, is intensely agitated, boiling as in a caldron, whilst dense clouds of steam are constantly ascending. As the passing breeze for a moment sweeps these away, one looks down with horror into a terrible seething pit. On three sides the walls are perpendicular, or overhanging cliffs of white sinter, rising some twenty feet above the water-surface. Their edges show the laminæ of deposition, and indicate that the orifice has been broken through the material laid down by an older spring.]

Running from the Cliff Caldron are numerous rills of hot water, which, united into two main streams, flow over a slope of terraced geyserite into the adjacent river. The channels are most brilliantly coloured, the underlying white rock forming a splendid background. Some portions run redly as with the blood from a slaughter-house, others present beautiful tints of yellow and orange, mingled with vivid green from minute vegetation; still others are lined with a delicate silky material vibrating with the water. The traveller walks warily with bated breath in this uncanny spot.

One writer, who has seen many dangers by land and sea, declares that he never before felt such feelings of absolute horror and dread as when standing on the brink of the Excelsior Geyser in Hell's Half Acre. [The whole area is one of death. Irreverent spirits are quelled and hushed to profound homage of the Great Power who created it.]

The eruptions of this monster geyser are few and far between, but when they do occur they are grand beyond description. But no eruption was needed to make me feel that I had supped full of horrors in one of the most awful scenes in the world.

A few yards west is situated the *Grand Prismatic Spring* (250 by 300 feet), the largest spring, as the Excelsior is the largest geyser, in the Park. The water is turquoise-tinted, becoming greener as it shallows towards the edge of the basin, but great clouds of steam render it difficult to properly view the place. Surrounding the opening are terraces of geyserite, beautifully curved and richly coloured. These are formed by the overflow.

Could Dante have seen this region he might have added another terror to his Inferno. "Now I believe in Hell," said a soldier of the escort of the President, who visited the Park in August, 1883.

I continued the return journey through the *Lower Geyser Basin* to the Fire Hole Forks. There are many interesting springs, geysers, and paint pots in this basin, but as before stated, time did not allow of a visit, and they, with many other minor marvels, must be passed over.

To Lord Dunraven the view of this wide flat part of the Fire Hole valley gave the impression : "That some modern Cities of the Plain had "been overwhelmed, and had so lately sunk amid flames into the "bowels of the earth, that the smoke of their ruins was still ascending "through heaps of smouldering ashes."

I lunched at Marshall's Hotel, and after bidding farewell to the kindly host, left with Henderson by the Norris-road, running north to the Gibbon Geyser Basin. The track ascends along wooded terraces, and approaches the Gibbon River in the neighbourhood of the *Falls.* The water, clinging closely to the dark rocks, spreads out into a foaming sheet full 80 feet in depth, forming a charming picture among the dusky pines.

We now enter the steep picturesque valley called the *Gibbon Cañon*, walled with igneous rock, rising at one place upwards of 2,000 feet. The road becomes in many places simply execrable, here running along the bank, undermined by hot springs, and there, out of despair, taking to the river-bed itself. The jolting was dreadful.

Emerging from the Cañon into meadow land, we dismount and make our way on foot through the forest to the *Gibbon Paint Pots*, a very curious place.

The springs are small, but numerous, and contain boiling mud of various colours; white, orange, red, green, etc. One of them, which throws water through a stratum of crimson mud, is called the *Blood Geyser.* There are, perhaps, 500 springs here. Clots of the pasty material, soft as velvet to the touch, are constantly being thrown out of the craters, and steam floats about among the pine-clad hills.

Returning to the waggon, we go on through the grassy glade of *Elk Park*, ascending the wooded hills on the north, and so reach the halting place for the night—the Tent Hotel—in the Gibbon Geyser Basin.

This was crowded by a contingent of the Rufus Hatch monster excursion party ; French, Germans, Americans, English. Of course all beds were bespoken, and about twenty of us—ladies and gentlemen—had to lie on the ground, in two rows, on opposite sides of the big dining tent, sleeping as best we could. I much regret being obliged to omit an account of this evening, with its amusing incidents, including that of the General—Generals are not uncommon out there—and his whisky bottle. (Mr. Hatch, of New York, is the President of the Park Improvement Company.)

25th AUGUST.—GIBBON GEYSER BASIN TO MAMMOTH HOT SPRINGS ; 21 MILES.

Gibbon Geyser Basin.—This morning I visited the Geyser Basin. It covers an area of about six square miles, and contains a considerable number of hot springs and geysers. There is a great bowl-shaped area, floored with white rock, and playing in it are the *Fountain*, the *Twins*, and the *Triplets*, which seem to be in constant action. The ground looked so unsafe that I was contented with a distant view. Steam clouds hang over the region in the early morning, clearing as the day advances.

Passing an interesting *Mud Geyser* (of which I watched the eruption) and a beautiful extinct geyser called the *Emerald Pool*, I walked on to the *Minute Man*, a hot fountain reputed to play once every sixty seconds. But he was evidently off work, had struck probably out of disgust at the tourists, and instead of spouting out his column, 25 feet in height, there was but the merest dribble, a tiny jet of about two inches ; although I watched a long time. Perhaps also an eruption of the great *Monarch Geyser* (not far away), which took place yesterday, shortly before we reached the spot, may have disconcerted the little fellow.

In this Basin are found two of the most interesting (from a scientific point of view) of the Park geysers—the *Steamboat Vent*, and the *New Geyser* ; for it is believed that a study of them will afford important data as to the building and age of the deposits.

About midday the journey north was resumed. We cross Norris Fork, and after ascending for some seven miles, and passing a very uncanny collection of old sulphur springs, the divide between the Gibbon and Gardiner rivers (7,800 feet above the sea) is reached. Here is a beautiful limpid lake, altogether surrounded by a dense growth of pines, and therefore appropriately called the *Lake of the Woods* Westward from this part of the road are fine views of the Gallatin Mountains.

Halting for lunch not far from the Lake, a place was chosen by the side of a clear stream, as its waters looked very tempting ; but when tried the liquid proved quite undrinkable, from the mineral matter in solution. It was also strongly acid, and we possessed no talisman, like the tree of the Law-giver, to sweeten this transatlantic Marah.

Two miles further on we descend to another beautiful sheet of water, *Beaver Lake*, dammed thirty or forty times by the busy creatures, who have both created and named it. This mere, lying in a rocky valley, is haunted by wild water-fowl. Upon its shores grow water-lilies and other flowers, and in the neighbourhood are traces of moraines, which probably began the work completed by the beavers.

Obsidian Cliff.—Obsidian Cañon, through which Obsidian Creek flows to the Gardiner River, is now entered, and attention is at once arrested by *Obsidian Cliff*, one of the most striking objects in the Park.

The Cliff, about a quarter of a mile long, rises to a height of 200 feet. It consists of black brittle volcanic glass, glistening like jet, richly variegated by streaks of brown and yellow, and by reddish spheroids of various sizes. The lower half of the cliff is beautifully columnar (the prevailing section being pentagonal); the upper half is an obscurely columnar mass of impure spherulitic obsidian.

This cliff has proved a most convenient quarry for the Indians, whose arrow-heads and other weapons are but the modern representatives of the flint implements used by prehistoric man in our own country.

[Note by T. H. Thomas on the occurrence of stations at which stone arrowheads were fashioned at Mammoth Hot Springs:—"During a visit to the Yellowstone National Park, in September-October, 1884, I took every opportunity which occurred to me to enquire for stone implements found in the Park, or traces of Indian stations at which they could have been made—the vast quantities of obsidian and agate in the district rendering it likely that so good a field for operations could not be neglected. I then heard of no such traces, but have since seen an account, with figures of the implements of obsidian, in the volume of the Government Survey.

"I had given up hopes of succeeding in my quest, when, on the last afternoon I spent in the Park, I went with Mr. Hobart, the proprietor of the Mammoth Hot Springs Hotel, to see the confluence of a boiling stream with the Gardiner river at the foot of the "White Mountain." Passing along the plateau (immediately above the river), composed of geyserite partially covered with cactus and sage-scrub, I noticed many chips of obsidian, and, on searching, we picked up, in the course of about an hour, three jasper arrowheads; and also came upon three, if not four, spots at which arrowheads had been fabricated. Small chips of obsidian, crystal, and variously coloured agates, and jasper, were scattered in a rough circle, as if around the Indian engaged in his occupation.

"None of the arrowheads found was of obsidian, but the great majority of the chips were of that substance. This may be accounted for by supposing that the arrowheads found were lost in hunting, or dropped; while the obsidian heads, made upon the spot, would be carefully pouched and carried away. Time did not allow of following up the subject further, but the matter is of interest, as traces of Indians in the district are few, the preternatural phenomena of the Park having daunted the Red Men, who seldom penetrated a region which they declared harboured 'Bad Spirits.'"]

In order to construct the track along the base of Obsidian Cliff, large fires were built upon the rock, which was then fractured by suddenly dashing cold water upon it. In this manner was formed what is probably the only glass road in the world. It is a quarter of a mile long.

At places in the Park, where stretches of marshy ground occur, the trail is paved with logs of wood laid across it side by side. These constitute what is called a "Corduroy," and no better instrument for administering violent jolts isochronously could be devised. It is to be regretted that many of the roads are in such a bad condition. A railway will be required before the region is properly accessible to the "tenderfoot" traveller.

Beyond Obsidian Cañon we continue the journey through pine-forests, then cross the middle Fork of Gardiner River, and enter the open meadow-land called *Willow Park.* The track passes by *Swan Lake*, behind which occur terraced moraines, and beyond these snow-patched mountains.

The valley narrows again, and moraines of most unmistakable character appear. We turn sharply to the right, and soon begin the tremendous descent of *Terrace Mountain*, at the foot of which lie the *Mammoth Hot Springs.* A road which goes down 3,000 feet in two miles may certainly be spoken of as pretty stiffly graded.

A grand view gradually unfolds itself: Sepulchre Mountain, Bunsen's Peak, Mount Evarts, the approaching Valleys of the Gardiner and Yellowstone, Look-out Hill, Liberty Cap, and the great calcareous Terraces of the White Mountain Hot Springs.

Here in the Basin is actually a real Hotel, the only one in the Park at all answering to our ordinary idea of such a building. It is a large handsome wooden erection, fitted with every luxury and convenience, including black-coated waiters, the electric light, prettily printed menus, and a Steinway grand pianoforte. Six months before my visit, the wood of which it is built was growing in the forest. Here may be seen Western characters and their ways. Here also I first saw the "Dude," who is, I believe, the American equivalent for Masher, only "more so."

26th AUGUST.—MAMMOTH HOT SPRINGS TO YANCEY'S LOG-CABIN; 16 MILES.

*Mammoth Hot Springs.**—This morning was devoted to exploring these remarkable springs, first called the *White Mountain* ones, from the colour of the mass in which they occur.

The formations (calcareous, not siliceous, as in most of the other spring areas) have all been built up by deposition from the water of the mineral matter (mainly calcium carbonate, with a little soda, silica, and magnesia), which it holds in solution. The results of the process are exquisitely beautiful. Coralline is the best word I can think of to describe the general appearance of the delicately moulded snowy-looking rock.

---

* See Lithograph.

Lookout Hill affords a fine view of the main terraces, fourteen in number, rising to a height of 200 feet above the plateau.

Seen looming through the steam clouds, floating upward from the pools, this view becomes at sunset truly gorgeous, for then the vivid colours with which the white travertine is stained are heightened to a new intensity.

Lookout Hill is clearly a portion of an old glacial moraine, and in the neighbourhood occur boulders and other evidences of old ice-action.

Two isolated shafts, called *Liberty Cap* (50 feet high) and *Giant's Thumb*, rise near the north of the plateau, and have evidently been built up by the overflow of water from their summits. They are now dead and decaying—the mausoleums of old geysers crumbling to dust.

[The ascent of the main terrace of active springs is not difficult. The way is threaded through a maze of rills of hot water over the low scalloped rims of limpid steaming pools, where it seems sacrilege to tread. The novelty and magnificence are bewildering. Not distance but proximity lends enchantment to the view. The brilliancy and variety of the colours, as well as the delicacy and beauty of the formations, are indescribable. Dr. Hayden considers the colours to be as brilliant as the brightest of our aniline dyes.

Terrace after terrace is surmounted, some large, others mere ledges. On each of these levels the water occurs in a long row of semi-circular basins lying close together. The higher terraces present an imposing front, the contour of their scalloped margins at once suggesting frozen waterfalls. Over the rims of the basins on the topmost level the water gently pours, until it finds its way into those next below, and repeats the process until it reaches the base, where the continually cooling water is collected and carried off by several channels to the Gardiner river.

The deposits which result from evaporation at the margin of each basin are exquisite in form and colour. The wavy rims are frilled and fretted as with delicate frost-work, and the outside of each bowl is adorned with a honey-comb pattern. The coating of the sides of the basins and pools take on many delicate and vivid tints, cream and salmon colours, deepening into red, brown, and yellow.]

The water is marvellously translucent, and where deep is of a lovely turquoise blue; where shallow it is marine-tinted and green; this change being due to the light reflected from the underlying white calcareous rock. The sun-glare from this rock is as trying as was that from the siliceous sinter in the Upper Geyser Basin.

On the surface of some of the pools may be seen a thin scum, as it were, of calcium carbonate; and another very curious feature is the vegetation flourishing in the cooler streams. Long silken-textured confervoid (?) growths, yellow, green, and brown, float in the water, and when petrified resemble coral. Sulphuretted hydrogen is given off at several places, and sulphur occurs in beautiful crystals amidst the calcareous deposits. Stalactites are in profusion, the whole mass in fact presents examples on the grandest scale of stalactitic and stalagmitic action. The entire area, covered by recent and extinct spring formations is estimated at three square miles, of which the recent ones occupy 170 acres. The highest temperature observed is 163°, and the lowest 112° Fahr.

The *Cleopatra* is the most beautiful spring in the Basin. It is situated on a mound of deposit forty feet high, and covers three-quarters of an acre. You stand upon the white margin looking down into the azure depths of the steaming water, and feel lost in contemplative wonder. The sides of the basin are tinted reddish yellow, and are tufted with long filaments vibrating with the movement of the fluid in which they float. Basins of varied colours and fringed with stalactites receive the overflow; but it is next to impossible to describe in words these marvels.

Then there are *Cupid's Cave*, the *Pulpit*, the *Orange Geyser*, and many other striking features, of which only the names can here be given.

As at other localities, where petrifying springs occur, numerous objects, such as pine cones, are submitted to the action of the water, in order to be sold afterwards. A coating about one-sixteenth of an inch in thickness is deposited in four days. The age of some of the extinct terraces is evidenced by that of trees of one hundred years' growth flourishing on them; whilst in the neighbourhood of active springs all forest growth is killed. It would seem that the present stage in the history of the Mammoth Hot Springs is one of decadence, the work of the past overshadows that of the present.

Near the hotel baths have been erected, and the use of them is said to be beneficial for skin diseases.

At lunch to-day I was privileged to meet Dr. Newberry, Professor of Geology at Columbia College, New York. He it was who first scientifically explored the Grand Cañon of the Colorado River of the West, a ravine of unique and unsurpassable sublimity. He was at this time greatly interested in the erosive power of ice, and did me the honour to take notes of some observations I made in Norway in 1882.

In the afternoon I left the springs in order to be able on the morrow to visit *Tower Falls*. For a short distance the main Gardiner River valley is followed, and then the road ascends the cañon of the East Fork of this river. On the left ranges *Mount Evarts*, an escarpment (2,000 feet high) of stratified rock, capped by a bed of columnar porphyry. This immense cliff, with its strangely eroded surface and beds of lava, takes rank among the most remarkable objects in the Park. The place is named from one of the explorers of 1870, who for thirty-seven days separated from his companions was at length discovered, almost dead, near the summit.

After following the road some distance, I looked back on the Mammoth Hot Springs from the high ground.

Their snowy deposits exactly resembled the protruding snout of a glacier, and yet no two things could well be in reality more dissimilar, the only point in common being that both move down hill. The contrast between the white rock and the sombre pines serves to still further heighten the deception.

We soon reach the picturesque *Gardiner Falls* (due to a hard ridge of basalt), and then crossing a flat divide, dotted with moraine mounds and granite boulders, come on the grassy plateaux and lava beds of Black-tail Deer Creek.

The track continues through the dry Cañon known as Devil's Cut (nearly opposite Hell-roaring Creek), and descends the mountain slopes for 2,000 feet to Pleasant Valley, in which is a log-cabin, kept by a hunter named Yancey.

Splendid views of mountain peaks beyond the Third Cañon of the Yellowstone were had during the descent. We stayed at the hut for the night, feasting on elk, which two pleasant young hunters had brought in as the result of their day's sport.

27th AUGUST.—YANCEY'S TO TOWER FALLS AND MAMMOTH HOT SPRINGS; 27 MILES.

Early this morning I left the cabin on foot for the Falls, which occur along Tower Creek, a tributary of the Yellowstone. Here this river flows through its Third Cañon (the Grand Cañon would be the Fourth), and displays a very interesting section of igneous rock. *Column Cliff*, as it is called, presents a series of beds of volcanic breccia and columnar basalt, forming a succession of inclined and vertical steps. At the head of the cañon comes in the East Fork of the Yellowstone, between which and the main stream rises the picturesque *Junction Butte*, rhyolite basalt-capped.

Tower Falls.—After viewing these from above, I made my way past some hot sulphur springs to the mouth of the Creek, and scrambled up to their base. I was kindly instructed how to proceed by a young American, whom I met near the spot (a Mr. Pierrepont, an Oxford graduate). He has since published an interesting volume, "From Fifth Avenue to Alaska," in which he refers to the above incident. At the time we met Mr. Pierrepont was out hunting elk, etc.

The Falls are very striking, and derive their name from slender obelisks and spires of volcanic breccia standing above and beside the cataract. A rainbow was visible.

[Tearing along in a rapid course the stream is suddenly contracted between two tall columns, which stand like gloomy sentinels at some temple gate; thence it leaps over a precipice, in an unbroken fall of 132 feet into a deep, dark gorge, so narrow that the sunlight visits it but for short intervals. Of the columns, some resemble towers, others spires, still others the slender minarets of a mosque. One capriciously shaped mass, from a supposed resemblance to the foot of his Satanic Majesty, is named the Devil's Hoof.]

South from Tower Creek the country rises in a great rounded sweep of prairie-like land to the summit of *Mount Washburn* (10,300 feet), by the side of which a trail leads to the Lower Falls of the Yellowstone.

On my way back to Yancey's I passed about noon a conspicuous series of moraine mounds, and hundreds of large and small granite boulders, bearing silent yet eloquent testimony to the great ice-sheet which in by-gone times mantled this part of the country.

In the afternoon we returned to the Mammoth Hot Springs. There I was delighted to meet some Americans whom I had parted with at San Francisco on the 13th. They had come north by a Pacific Coast steamer, and then east by rail, being among the very first to travel over the newly-completed western half of the Northern Pacific Railroad. To one of these gentlemen—President of the Board of Education of New York—I shall ever feel indebted for a personal kindness, which cannot here be more than mentioned. At dinner in the hotel, one of these friends came over and introduced me to my neighbour at table. He turned out to be the Hon. Edwards Pierrepont, U.S. Ambassador in England during part of the Presidency of the late much honoured General Grant. I had a most interesting conversation with him about our Royal Family (of whom he spoke in terms of unmeasured praise); about Alaska (the Norway of America), which he had just visited, and other matters, which space now forbids me to dwell on.

One anecdote only shall be given. Telling him that I happened to meet his son that morning near Tower Falls, and that I at once knew him, by his way of speaking, for an American, E. P. replied:—"Yes; but you would not have so known him when he first came back from Oxford; but he has now returned to his original purity of accent."

In company with my American friends and the English lady (before mentioned), a most pleasant social evening was spent. This lady is, I believe, the first of our countrywomen who has, unattended, explored the Yellowstone National Park.

28th AUGUST.—MAMMOTH HOT SPRINGS TO LIVINGSTON; 62 MILES.

The stage road, by which I left the Park, runs by Gardiner River Valley for some four miles, nearly to where that stream joins the Yellowstone, along the valley of which it continues for about ten miles. The road is then left, and the northward journey completed by rail to Livingston. Taking a final look back on the Hot Spring formation, one sees again the striking resemblance which the mass of snowy whiteness bears at a distance to the protruding end of a glacier. The northern boundary of the Park is crossed four miles north of the Mammoth Hot Springs.

Left and right of the route rise lofty picturesque mountains (*Electric Peak*, 11,155 feet, is the highest in the Park), and about us lie moraines and boulders in profusion.

Cinnabar Mountain and the Devil's Slide.—A few miles down below the point at which we reach the Yellowstone Valley, stands on our left *Cinnabar Mountain*, so called from a broad stripe of brilliant vermilion colour conspicuous on its face, but there is none of the mercurial mineral actually present.

Two nearly vertical parallel ridges of hard rock (200 feet high) project from the south side of this mountain, owing to the washing away of softer material between them. The startling name—*Devil's Slide*—

was given to this strange structure by the early explorers, and aptly conveys the idea of its utter unfitness for being slidden upon by earthly beings. Geologically it is one of the most interesting places in the Park, the strata being exposed and turned up in a notable manner.

Second Cañon of the Yellowstone. Glaciers.—Soon after starting in the train we pass through the *Second Cañon*, a wild and terrible gorge, through which the river, foaming among large boulders, forces its way. So clear and extensive are the results of old ice-action in this cañon, that Professor A. Geikie infers that the Yellowstone Glacier must have been massive enough to fill it to the brim ; this would require the ice to be about one thousand feet thick. The scene recalls that of the glacier-ground Aar valley above the Grimsel.

Beyond the gorge the ravine broadens into a wide fertile plain, called *Paradise Valley*, in which are comfortable houses, inhabited by prosperous ranchmen. Along the sides of the valley the glacial detritus has been re-arranged (either by lake or river action) in a series of well-defined terraces.

High on the east rises a magnificent range of lofty mountains, bearing on their summits evidence for their name—the Snow Mountains—and among them is the huge bulk of *Emigrant Peak*, 11,034 feet.

Again the valley narrows ; we pass through the *Lower* or *First Cañon* ; two miles beyond which, at the gate of the mountains (where the Yellowstone turns east), lies Livingston.

Livingston.—Here connection is made with the new great transcontinental railway, the Northern Pacific, opened through in 1883. At the date of my visit Livingston was about eight months old, and boasted a population of 3,000. The houses are wooden erections hastily run up. There are lots of stores, and a quite superfluous number of drinking hells or saloons licensed for gambling. The place is a typical example of a "booming" young Western Town, and has probably a great future before it, though its present reputation is not of the most moral kind.

On the way east to St. Paul, I had the good fortune to meet on board the cars (*i.e.*, in the train) Mr. N. P. Langford, the first Superintendent of the Park, whose vivid description of the Washburn Expedition of 1870 had done so much to draw public attention to the Wonderland.

He was most cordial and pleasant. We became quite friendly, and as his surname is the same as one in my own family, I trust we are not very distant cousins. Feats similar to his Rocky Mountain exploits, if performed in Switzerland, would have placed him high among men of daring in the Alpine Club. Mr. Langford was also a treasure-house of anecdotes, which he told in a most racy and amusing way. After his first account of the Yellowstone National Park had been published, he was actually described by the sceptical newspapers as "the Biggest Liar in the West." This quite unique description means a great deal, I can assure you ; for Western American lying is not to be measured by any of our puny European standards of untruthfulness.

Among places in or near the Park, which time did not allow me to visit, may be named the greater part of the Lake, also Shoshone, Lewis, Heart, Lake, and others, each with its geysers and hot springs; Monument Geysers, Mount Washburn, Dunraven Peak, Mount Langford, Amethyst Mountain, Fossil Forests (a vegetable Herculaneum), Hoodoo Labyrinths, or Goblin Mountain, the Tetons, etc., to say nothing of the lofty ranges girdling the region.

Fauna.—In the Park are found elk, moose, black-tailed deer, antelopes, big-horn sheep, bears, mountain lions (rare), foxes, coyotes, beavers, rock dogs, chipmunks, skunks, etc.; grouse, hawks, eagles, jackdaws, bluejays, geese, pelicans, swans, etc.; trout, grayling, etc.; reptiles, next to none.

Flora.—Seventy-seven per cent. is covered with forest. Fir, spruce, pine, poplar, maple, willow, bunch-grass, larkspur, harebell, evening primrose, gentian, spurge, daisies, buttercups, forget-me-nots, utricularia, triglochin, etc.

Minerals.—Agate, alum, amethyst, hornblende, calcite, carnelian, chalcedony, felspar, geyserite or siliceous sinter, really a variety of opal, gypsum, jasper, obsidian, opal, quartz (in the varieties already named, and others), sulphur, travertine, viandite, etc.

Rocks.—Of these there is a great variety, but until they have been properly examined it will be impossible accurately to name them. Igneous rocks cover the greater portion of the Park, and among them are basalt, trachyte, obsidian, rhyolite, andesite, granite, conglomerates, breccias, ashy beds, etc.

The Aqueous rocks include representatives from the Silurian to the Recent deposits; sandstones, limestones, and clays. Specimens of some of the rocks and minerals may be seen in the Cardiff Free Library Museum.

Origin and Theory of Geysers, &c.—I now proceed to give a condensed account of some interesting subjects arising out of a consideration of the natural phenomena of the geysers. (For further details see the Survey Volume.)

Thermal Springs.—These are springs whose mean annual temperature exceeds that of the locality in which they are found. There appears to be a connection between hot springs and the *disturbance* of the rocks among which they occur; such rocks are folded, or fractured, or they contain volcanic material.

The *meteoric* origin of the water of geysers and thermals has been proved. Ultimately they depend for their supply on the rainfall.

The only instance of the presence of animal life in the hot springs of the Park is the discovery of the larvae of *Helicopsyche* in water having a temperature of 108°. Confervoid growths occur in water of a temperature as high as 132°.

Whilst hot springs are common, geysers are rare. These latter are known only in Iceland, New Zealand, the Azores, Thibet, and the Yellowstone National Park.

Connection of Volcanoes with Geysers.—Water is present in all volcanic eruptions. Geysers would appear to be evidence of *waning* volcanic activity. A geyser is distinguished from a hot spring or thermal by its eruptions. But it is not always easy to decide between the two; for the great principle of continuity obtains in this case as in others. When not actually in violent action, the majority of geysers are tranquil.

Chemical Classification of Springs.—1, Calcareous; as Mammoth Hot Springs. 2, Aluminous; Hayden's Valley Mud Springs, etc. 3, Siliceous; majority of the Yellowstone National Park Springs.

Therapeutic effects—Not yet sufficiently studied.

Comparison of the three principal geyser areas: Iceland, New Zealand, Yellowstone National Park.—In Iceland, 6 areas, 40 or 50 miles apart, and covering 5,000 square miles. New Zealand, 10 areas, 15 miles apart, and covering 2,500 square miles. Yellowstone National Park, 30 or 40 areas, only 16 miles apart at greatest distance, and covering 3,578 square miles. Number of springs and geysers in Iceland is much the least of the three. Height of the eruptions is about the same on the average. Lakes with associated hot springs occur in all three localities. The groups of springs are in parallel lines, reminding one of the linear arrangement characteristic of volcanoes. The rocks (acidic volcanic) and the deposits are similar in the three areas.

In New Zealand the springs generally are larger than in the other localities, and basins predominate in number over cones and chimneys. In order of *age* the localities (beginning with the youngest) would be arranged thus: Iceland, New Zealand, Yellowstone National Park. Iceland young, some volcanoes still active, chimney-like cones absent. New Zealand middle-aged, volcanoes in the solfataric stage, cones of moderate size. Yellowstone National Park old, volcanoes extinct and their sites not exactly determinable, cones well developed.

The *formations* and their ornamentation in the three localities are very similar. *Calcareous* springs constantly form beautiful bath-like basins arranged in terraces; *e.g.*, Mammoth Hot Springs.

The same form of basin is seen in siliceous springs, but is not so marked. The best example is at Rotomahana, in New Zealand. Here is the celebrated Te Tarata, or Tattooed Rock. The terraced deposits, as white as if of marble, are ranged along the hill-slope, and present the appearance of a cataract suddenly turned into stone. They occupy an area of about three acres. On the upper plateau is placed the celebrated hot spring, the snow-white basin (60 by 80 feet) of which is filled with water of a beautiful turquoise-blue tint. Many of the Fire Hole river geyser basins show terraces on a small scale.

In Iceland and New Zealand the basins and pools (generally circular) are similar to those in the Yellowstone National Park. The ornamentation is alike in all regions where siliceous springs occur. One curious shape often taken by the sinter is that of globular masses. The presence of *iron* usually causes the deposits to be brilliantly coloured.

The *Colour* of the water in the springs is a very interesting subject, well deserving investigation.

Source of Heat.—Geysers are always in volcanic areas, and in all probability the heating is due to hot volcanic rocks. No *boiling* springs are known outside of volcanic areas.

The *Chemistry* of the *Thermal Waters* is a matter full of interest, but not as yet worked out. In the Park siliceous springs predominate, except in the Gardiner river deposits, where they are mainly calcareous. Besides silica and carbonate of lime, there are found common salt, sulphates of soda and lime, carbonate of magnesia, etc.

Silica is *the* characteristic substance in all boiling springs and geysers, and is derived from the volcanic silicates. The calcareous springs obtain their main ingredients from limestone. The sulphur is supposed to come from the decomposition of sulphides by organic matter, and in connection with this it may be noted that sulphur is characteristic of the beds of rock deposited in the lakes. Alumina is due to the beds of clay. Carbonic acid and sulphuretted-hydrogen gas are frequently found in the waters.

Physical features of the deposits.—Thousands of acres are covered with siliceous material; and some three square miles, at the Mammoth Hot Springs, with calcareous matter. The main cause of deposition is the evaporation of the water. The form, pattern, and substance of the deposits present a fruitful field to the observer.

The geyserite may resemble a cauliflower, a mushroom, a piece of porcelain, or may have a bronze-like surface, or be laminated, or beaded, or columnar, or like coral, etc. Then there are basins, mounds, cones, craters, chimneys. We seem to detect stages of growth in some of the craters. First a large bowl, filled up gradually by a mound of laminated deposits; then a platform built on this mound, and later on the present cone or crater.

No Yellowstone National Park geyser presents so simple a form as that of the Great Geyser of Iceland—a saucer-like basin surmounting a tube 72 feet in depth.

As a volcanic cone grows by the heaping up of the falling ejected ashes, so a geyser cone grows by the deposition by evaporation of the dissolved minerals contained in its ejected water. A geyser erupts water, a volcano rock; both are autarchitectonic.

Chemistry of the *Deposits.*—The deposits may be grouped under three heads: travertine, siliceous sinter, aluminous or mud deposits.

Travertine, also called calc sinter and calcareous tufa, is found in the Park at the Mammoth Hot Springs.

Siliceous sinter, fiorite, or geyserite, is abundant in most of the spring localities of the Park. It is a variety of opal, which is hydrated silica. A series may be formed, first silica in solution, then gelatinous silica or viandite, then varieties progressively harder as the proportion of water diminishes.

The aluminous deposits appear to consist of hydrated silicate of alumina; they are found in the mud springs.

Theory of Geysers.—A geyser is defined as a periodically eruptive *hot* spring. It has been noticed that they occur where the intensity of volcanic action is decreasing. Near active volcanoes the temperature is too high, and the vapour escapes as steam from what are called stufas.

Of eruption theories Bunsen's, based upon his Icelandic observations, appears to be the true one.

Before an eruption commences the temperature of the water column, at any given point in the geyser-tube, is below the boiling temperature corresponding to the pressure at that point. Steam is constantly flowing in below. As the time for an eruption approaches the column is lifted, and so the nearly boiling water of a particular level is raised to a level where the pressure upon it is less than that required to keep it from ebullition. The result is a sudden violent generation of steam, followed by an eruption. The layers of water being successively relieved of the pressure rise and flash explosively into the gaseous form, until the ebullition has descended to near the bottom of the tube.

The character of the water supply, and the different sizes and shapes of the main tube, and of its tributary tubes and reservoirs, will of course bring about great variations in the eruptions in the case of different geysers. The absence of sympathetic or synchronous action has been already pointed out.

Briefly to recapitulate the conditions necessary for geysers :—(1), The presence of igneous rocks, still retaining their heat at a considerable distance below the surface ; (2), meteoric water having access to these rocks ; (3), a tube by which the heated water can reach the surface.

With this brief sketch of the theoretical side of the subject this paper must conclude.

The early explorers of the Yellowstone National Park, awe-struck by the fearsome aspect of the place and its phenomena, bestowed liberally upon it names associated with Satanic influences.

May not we (learned in all the wisdom of modern science), with a truer reverence, regard this wondrous land—graven by the finger of God—as the Sinai of the West ?